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Prevalence of chronic diarrhea and its association with obesity in a Chinese community-based population

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Abstract

Background: Epidemiological data on chronic diarrhea in the Chinese population are lacking, and the association between obesity and chronic diarrhea in East Asian populations remains inconclusive. This study aimed to investigate the prevalence of chronic diarrhea and its association with obesity in a representative community-dwelling Chinese population.

Methods: This cross-sectional study was based on a multistage, randomized cluster sampling involving 3503 residents aged 20–69 years from representative urban and rural communities in Beijing. Chronic diarrhea was assessed using the Bristol Stool Form Scale (BSFS), and obesity was determined based on body mass index (BMI). Logistic regression analysis and restricted cubic splines were used to evaluate the relationship between obesity and chronic diarrhea.

Results: The standardized prevalence of chronic diarrhea in the study population was 12.88%. The average BMI was 24.67 kg/m^2. Of all the participants, 35.17% (1232/3503) of participants were classified as overweight and 16.13% (565/3503) as obese. After adjustment for potential confounders, individuals with obesity had an increased risk of chronic diarrhea as compared to normal weight individuals (odds ratio = 1.58, 95% confidence interval: 1.20–2.06). A nonlinear association between BMI and the risk of chronic diarrhea was observed in community residents of males and the overall participant group ($P = 0.026$ and 0.017, respectively).

Conclusions: This study presents initial findings on the prevalence of chronic diarrhea among residents of Chinese communities while offering substantiated evidence regarding the significant association between obesity and chronic diarrhea. These findings offer a novel perspective on gastrointestinal health management.

Keywords: Chronic diarrhea; Obesity; Prevalence; Bristol Stool Form Scale; Body mass index

Introduction

Currently, there are 3.39 billion adults with obesity or overweight worldwide.[1] Obesity-related health problems have become a global problem, significantly increasing disease burdens and severely impairing people's quality of life.[2] Obesity is a direct risk factor for gastrointestinal diseases.[3] It is closely related to gastrointestinal symptoms, including upper abdominal pain, heartburn, reflux esophagitis, and diarrhea.[4] Chronic diarrhea deserves attention in populations with obesity-related conditions. The coexistence of obesity and chronic diarrhea appears paradoxically. It is generally believed that obesity is caused by increased absorption of nutrients, diarrhea causes nutrient loss, and long-term diarrhea causes weight loss. However, conventional knowledge has failed to explain chronic diarrhea in patients with obesity who have no organic diseases. Feasibly, it should be regarded as a syndrome and approached holistically from an etiological perspective.[5,6]

Previous epidemiological studies have primarily reported the prevalence of diarrhea-predominant irritable bowel syndrome (IBS-D)[7–9] and functional diarrhea,[10] but there has been a lack of systematic reports on the prevalence of chronic diarrhea. Consequently, this may have led to underestimating the disease burdens associated with chronic diarrhea. Previous studies have indicated an increased incidence of diarrhea among individuals with obesity,[4,11–13] but the data that are specific to the East Asian populations are still lacking. Although several studies have shown that obesity is closely related to chronic diarrhea,[14–19] a higher prevalence of constipation has been reported in overweight and obese populations.[20,21]

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Further studies are required to gain deeper insights into the epidemiological characteristics of the association between obesity and chronic diarrhea.

Therefore, we described the epidemiological characteristics of chronic diarrhea and validated the association between obesity and chronic diarrhea in a Chinese population representative of urban and rural communities. This study aimed to estimate the prevalence of chronic diarrhea further and provide a foundation for exploring preventive strategies and management approaches.

Methods

Ethical approval and consent to participate

This study involving human participants was in accordance with the ethical standards of the Institutional and National Research Committee and with the 1964 *Helsinki Declaration* and its later amendments or comparable ethical standards. Ethics approval was obtained from the Chinese People's Liberation Army General Hospital Ethics Committee (No.S2022-677-01), and informed consent was obtained from all participants.

Participants

This study recruited participants from the Beijing Community Gut Health Survey (BCGHS). It used a cross-sectional design and a two-stage randomized whole-cluster sampling method to conduct an epidemiological survey of intestinal health in representative urban and rural areas of Beijing from April 2022 to June 2023.

This study included individuals aged 20–69 years, who could understand research-related instructions and cooperate to complete the evaluations. The individuals with severe disease or functional impairments and cognitive issues who could not answer questions appropriately and those unwilling to participate were excluded. After excluding those with incomplete information and unqualified data, 3503 participants were finally included, with a questionnaire qualification rate of 93.76% [Figure 1].

The urban area samples were derived from the natural population in the Tiancun Road and Yongding Road Subdistricts of Haidian District, Beijing, representing the urban area's territorial and economic conditions and community life characteristics of urban residents. In the first stage, random cluster sampling was conducted across all the residential communities, securing target communities that represented 10% of the total community. A total of five target communities (each containing approximately 300–600 households) were selected. In the second stage, all the households in each target community were included, and one resident meeting the inclusion and exclusion criteria was randomly selected from each household for the study.

The rural sample was derived from the natural population of Wangxinzhuang Town, Pinggu District, Beijing, China. This area is located in the far suburbs of Beijing that connects to the urban areas to the south, and extends to

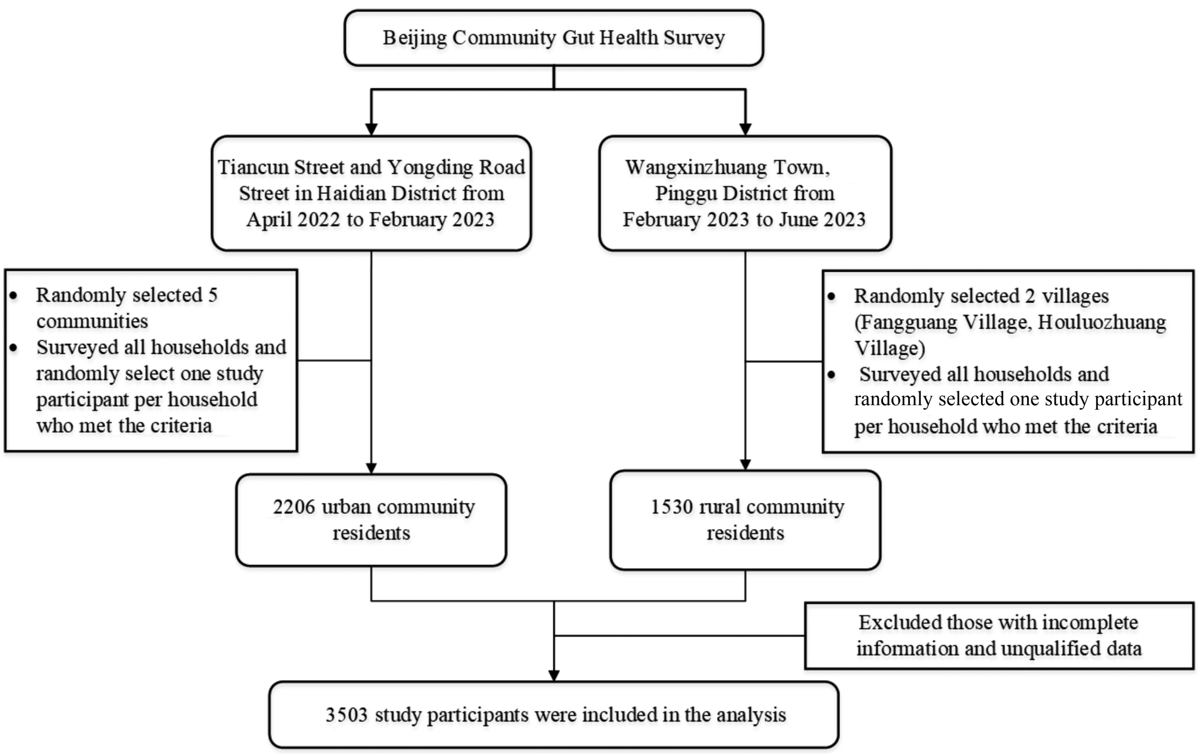

Figure 1: Flowchart of participant enrolment. The urban samples were obtained from the natural population of Tiancunlu Street and Yongdinglu Street in Haidian District, while the rural samples were derived from Wangxinzhuang Town in Pinggu District. A multi-stage random cluster sampling method was employed to select community residents in the respective areas. The survey was conducted through household interviews, involving face-to-face questionnaire interviews and measurements of anthropometric indicators.

the foothills of the Yan Mountains to the north. A combination of urban–rural and mountain–plain socioeconomic and geographic features characterizes the area. Initially, random cluster sampling was conducted across all the village communities in Wangxinzhuang Town. Fangguang and Houluozhuang villages were selected as representative rural communities. In the second stage, all the permanent resident families in these two villages were included, and one resident who met the inclusion criteria was randomly selected from each household as a survey participant.

Data collection

Structured survey questionnaires were completed via mobile or tablet devices following face-to-face interviews with the survey subjects. The survey questionnaire included questions on general demographic characteristics, lifestyle habits, history of current disease, family history, comprehensive intestinal health assessment, and social and psychological health evaluations. Anthropometric indicators, such as height and weight, were measured. Calibrated instruments were used in accordance with standard procedures. The interviews and surveys were conducted by healthcare personnels with relevant backgrounds who had undergone standardized training. Semi-structured questionnaires were used for face-to-face interviews with participants, and quality control personnel checked the collected data. The instruments and materials used on-site were procured centrally and calibrated to ensure the accuracy, reliability, and comparability of the measurement results. Multiple channels were used for follow-up monitoring and cross-validation. The data were managed and standardized with logical checks, outlier handling, and an anonymous review.

Chronic diarrhea and obesity

Chronic diarrhea was assessed using the Bristol Stool Form Scale (BSFS), a widely used and validated tool for evaluating stool form and consistency.[22,23] Interviewers presented the participants with descriptions and color images of the seven types of BSFS stool forms. The participants were asked with the following questions, "Please describe your bowel movements over the past month and indicate the corresponding number that best represents your usual or most common type of stool". In this study, chronic diarrhea was defined as BSFS type 5 (soft blobs with clear-cut edges), type 6 (mushy consistency with ragged edges), or type 7 (watery, no solid pieces)[24,25] with no reported history of inflammatory bowel disease (IBD), hyperthyroidism, cancer, or prior gallbladder surgery.

Body measurements were taken using a height and weight meter, and the measurements followed standard procedures. Height was assessed with shoes and hats removed, and the participants were asked to stand upright with their backs against a measuring tape. The measurements were taken to an accuracy of 1 cm. Weight was measured using light clothing without shoes, and the measurements were taken to an accuracy of 0.5 kg. Repeated measurements verified all measurements, and averages were obtained. Body mass index (BMI) was calculated as body weight in kilograms divided by the square of the body height in meters. As per the recommended categorizations for Chinese adults,[26] underweight was defined as a BMI less than 18.5 kg/m^2, normal weight as a BMI between 18.5 kg/m^2 and 23.9 kg/m^2, overweight as a BMI between 24.0 kg/m^2 and 27.9 kg/m^2, and obese as a BMI of 28.0 kg/m^2 or higher.

Covariates

Demographic variables included age, sex, place of residence, ethnicity, marital status, occupation type, education level, and annual household income. We also considered lifestyle characteristics, including smoking status and alcohol consumption (current, former, or never), as well as the frequency of exercise or activities lasting more than 30 min per week. The dietary survey included animal meat, eggs, fish and shrimp, beans and soy products, milk and dairy products, vegetables, fruits, grains, tuber, and fat intake. Dietary frequency was categorized into four levels: almost never consumed, infrequently consumed ($\leq$1 time per week), frequently consumed (2–5 times per week), and consumed almost daily. The patient health questionnaire-9 (PHQ-9) was used to assess depressive symptoms. The presence of depressive symptoms was defined as a score $\geq$5 or above.[27]

Statistical analysis

Continuous variables are expressed as mean $\pm$ standard deviation (SD), while categorical variables are presented as frequencies (percentages). The baseline characteristics of the variables are described according to the chronic diarrhea status group. The differences between groups for continuous variables were compared using Student's *t*-test, whereas the differences between groups for categorical variables were compared using the chi-squared test (χ^2 test). We calculated the prevalence of chronic diarrhea in different sexes, age groups, and BMI categories. Additionally, we standardized the prevalence rates using the sex and age distribution of the Beijing population in 2010 as a reference. Differences in prevalence rates between groups were compared using the chi-squared test. Logistic regression analysis was used to calculate the odds ratios (ORs) for chronic diarrhea associated with different levels of obesity. BMI categories were used as categorical independent variables, and a stratified analysis was conducted based on sex. To mitigate subjectivity in categorization and the risk of information loss, we further employed restricted cubic splines with five knots at the 5th, 35th, 50th, 65th, and 95th percentiles to flexibly model the nonlinear relationship between BMI and chronic diarrhea. Based on previous epidemiological evidences,[14,16] multivariable analysis was adjusted for the potential effects of demographic characteristics, lifestyle, dietary factors, and depressive status. A stepwise regression method was adopted to counteract the effects of the statistical power. All statistical analyses were conducted using SPSS Statistics (version 28.0; IBM Corporation, Armonk, NY, USA) and Empower Stats software (X&Y Solutions Inc., Boston, MA, USA). Statistical significance was set at P <0.05 (two-tailed).

Results

Baseline characteristics

Supplementary Table, http://links.lww.com/CM9/C55 summarizes the patient characteristics of the 3503 participants (1527 men and 1976 women) according to the categories of chronic diarrhea. The participants had an average age of 46.9 ± 12.6 years. Of all, 1433 participants (40.91%) were from rural areas, and 2070 (59.09%) were from urban areas. Among the 3503 participants, 502 (237 men and 265 women) were diagnosed with chronic diarrhea, accounting for 14.33% of the total population. The average BMI was 24.7 ± 4.6 kg/m^2. A total of 35.17% (1232/3503) of the participants were overweight, and 16.13% (565/3503) were obese. There was a significant difference in the BMI between the two groups (P <0.001). Significant differences were observed between chronic diarrhea and reference groups in terms of marital status, smoking status, alcohol consumption, depressive symptoms, and milk, dairy products, and fat intake.

Prevalence of chronic diarrhea

Table 1 presents the prevalence of chronic diarrhea in the study population, stratified by BMI, age, and sex. The standardized overall incidence rate of chronic diarrhea in the Beijing community was 12.88%, with 14.20% in males and 11.77% in females. The age group of 40–49 years exhibited the highest prevalence of chronic diarrhea (17.52%; 19.16% for men; 16.31% for women). In the overall participants and males, we observed a significant increase in the prevalence of chronic diarrhea with increasing body weight across most age groups (P <0.05). The overall standardized prevalence of obesity–diarrhea comorbidity was 2.89%, with male and female residents having a prevalence of 4.36% and 1.69%, respectively.

Association of BMI and obesity with chronic diarrhea

As shown in the Table 2, continuous and categorical forms of BMI were used as independent variables, whereas binary chronic diarrhea status was the dependent variable. Demographic characteristics and other covariates that met the selection criteria were gradually adjusted, followed by a multivariable Logistic regression analysis. Across the entire study population, the risk of chronic diarrhea increased by 4% for each 1 kg/m^2 BMI increase (OR = 1.04, 95% confidence interval [CI]: 1.02–1.06, P <0.001). In males, every 1 kg/m^2 increase in BMI was associated with a 6% increased risk of chronic diarrhea (OR = 1.06, 95% CI: 1.03–1.10, P <0.001), whereas no statistically significant association was observed in females (OR = 1.02, 95% CI: 0.99–1.04, P = 0.183). Compared with the normal-weight group, the multivariable Logistic analysis revealed a significant association among overweight, obesity, and chronic diarrhea (fully adjusted model: overweight, OR = 1.36, 95% CI: 1.09–1.70, P = 0.007; obesity, OR = 1.58, 95% CI: 1.20–2.06, P <0.001). Among men, the risk of chronic diarrhea was 1.36 times higher in obese individuals than in the normal weight group (fully adjusted model, OR = 2.36, 95% CI: 1.58–3.53, P <0.001), whereas in women, this association was not statistically significant (fully adjusted model, OR = 1.08, 95% CI: 0.73–1.61,

Table 1: Prevalence of chronic diarrhea among urban and rural residents in Beijing, categorized by age, sex, and BMI category.

	BMI categories						
Age group	Underweight (<18.5 kg/m^2)	Normal weight (18.5–23.9 kg/m^2)	Overweight (24.0–27.9 kg/m^2)	Obesity (≥28.0 kg/m^2)	Total	χ^2	P value†
All participants	6.35% (8/126)	11.96% (189/1580)	16.15% (199/1232)	18.76% (106/565)	14.33% (502/3503)	25.341	<0.001
20–29 years	7.14% (2/28)	5.42% (9/166)	12.07% (7/58)	11.54% (6/52)	7.89% (24/304)	0.024	0.121
30–39 years	8.89% (4/45)	12.01% (46/383)	17.57% (39/222)	22.56% (30/133)	15.20% (119/783)	10.822	0.001
40–49 years	0 (0/25)	15.52% (61/393)	19.75% (63/319)	20.61% (34/165)	17.52% (158/902)	5.686	0.017
50–59 years	5.26% (1/19)	11.05% (38/344)	14.16% (50/353)	18.18% (22/121)	13.26% (111/837)	5.214	0.022
60–69 years	11.11% (1/9)	11.90% (35/294)	14.29% (40/280)	14.89% (14/94)	13.29% (90/677)	0.876	0.349
Standardized prevalence*	6.05%	10.47%	15.45%	17.29%	12.88%	–	–
Male	3.13% (1/32)	10.22% (60/587)	17.77% (110/619)	22.84% (66/289)	15.52% (237/1527)	30.068	<0.001
20–29 years	0 (0/9)	4.11% (3/73)	18.18% (6/33)	14.29% (5/35)	9.33% (14/150)	4.980	0.026
30–39 years	10.00% (1/10)	10.08% (12/119)	17.39% (24/138)	22.78% (18/79)	15.90% (55/346)	6.006	0.014
40–49 years	0 (0/6)	11.45% (15/131)	21.94% (34/155)	26.97% (24/89)	19.16% (73/381)	10.197	0.001
50–59 years	0 (0/3)	10.56% (15/142)	15.24% (25/164)	22.95% (14/61)	14.56% (54/371)	5.798	0.016
60–69 years	0 (0/4)	12.30% (15/122)	16.28% (21/129)	20.00% (5/25)	14.70% (41/279)	1.733	0.188
Standardized prevalence*	2.31%	8.71%	18.20%	20.79%	14.20%	–	–
Female	7.45% (7/94)	12.99% (129/993)	14.52% (89/613)	14.49% (40/276)	13.41% (265/1976)	2.360	0.124
20–29 years	10.53% (2/19)	6.45% (6/93)	4.00% (1/25)	5.88% (1/17)	6.49% (10/154)	0.411	0.522
30–39 years	8.57% (3/35)	12.88% (34/264)	17.86% (15/84)	22.22% (12/54)	14.65% (64/437)	4.847	0.028
40–49 years	0 (0/19)	17.56% (46/262)	17.68% (29/164)	13.16% (10/76)	16.31% (85/521)	0.007	0.934
50–59 years	6.67% (1/15)	11.39% (23/202)	13.23% (25/189)	13.33% (8/60)	12.23% (57/466)	0.586	0.444
60–69 years	16.67% (1/6)	11.63% (20/172)	12.58% (19/151)	13.04% (9/69)	12.31% (49/398)	0.053	0.817
Standardized prevalence*	7.84%	11.41%	12.15%	12.85%	11.77%	–	–

*The prevalence was standardized according to the sex and age composition of the Beijing population in 2010. †The chi-squared linear trend test was used to compare the differences in rates between groups. BMI: Body mass index. –: Not available.

Table 2: Association between BMI categories and chronic diarrhea.

	Model 1		Model 2		Model 3		Model 4	
Parameters	**OR (95%CI)**	***P* value**	**OR (95%CI)**	***P* value**	**OR (95%CI)**	***P* value**	**OR (95%CI)**	***P* value**
Total								
Per 1.0 kg/m^2	1.04 (1.02, 1.06)	<0.001	1.04 (1.02, 1.06)	<0.001	1.04 (1.02, 1.06)	<0.001	1.04 (1.02, 1.06)	<0.001
Normal weight	Ref.		Ref.		Ref.		Ref.	
Underweight	0.50 (0.24, 1.05)	0.068	0.52 (0.25, 1.08)	0.080	0.49 (0.23, 1.03)	0.060	0.47 (0.22, 0.98)	0.046
Overweight	1.40 (1.13, 1.74)	0.002	1.39 (1.11, 1.73)	0.004	1.35 (1.08, 1.69)	0.007	1.36 (1.09, 1.70)	0.007
Obesity	1.68 (1.29, 2.18)	<0.001	1.71 (1.31, 2.22)	<0.001	1.56 (1.19, 2.04)	0.001	1.58 (1.20, 2.06)	<0.001
Male								
Per 1.0 kg/m^2	1.07 (1.04, 1.10)	<0.001	1.07 (1.04, 1.11)	<0.001	1.06 (1.03, 1.10)	<0.001	1.06 (1.03, 1.10)	<0.001
Normal weight	Ref.		Ref.		Ref.		Ref.	
Underweight	0.28 (0.04, 2.11)	0.218	0.32 (0.04, 2.40)	0.267	0.31 (0.04, 2.36)	0.259	0.29 (0.04, 2.23)	0.237
Overweight	1.90 (1.35, 2.66)	<0.001	1.82 (1.29, 2.56)	<0.001	1.78 (1.26, 2.52)	0.001	1.77 (1.25, 2.51)	0.001
Obesity	2.60 (1.77, 3.81)	<0.001	2.63 (1.78, 3.89)	<0.001	2.38 (1.59, 3.54)	<0.001	2.36 (1.58, 3.53)	<0.001
Female								
Per 1.0 kg/m^2	1.02 (1.00, 1.05)	0.087	1.02 (1.00, 1.05)	0.113	1.02 (0.99, 1.04)	0.202	1.02 (0.99, 1.04)	0.183
Normal weight	Ref.		Ref.		Ref.		Ref.	
Underweight	0.54 (0.24, 1.19)	0.126	0.55 (0.25, 1.22)	0.139	0.53 (0.23, 1.18)	0.121	0.51 (0.23, 1.14)	0.102
Overweight	1.14 (0.85, 1.52)	0.385	1.13 (0.84, 1.52)	0.431	1.08 (0.80, 1.46)	0.626	1.09 (0.81, 1.48)	0.567
Obesity	1.14 (0.77, 1.66)	0.516	1.13 (0.77, 1.67)	0.530	1.07 (0.72, 1.59)	0.737	1.08 (0.73, 1.61)	0.697

Data are shown as OR (95%CI). BMI: Body mass index; CI: Confidence interval; OR: Odd ratios; Ref.: Reference. Model 1: Unadjusted crude model. Model 2: Adjusted for age, sex, place of residence, ethnicity, marital status, type of occupation, level of education, and annual household income. Model 3: Adjusted based on model 2 plus smoking status, alcohol drinking status, weekly exercise times, and depressive status. Model 4: Adjusted based on model 3 plus daily consumption of animal meat, egg, fish and shrimp, beans and soy products, milk and dairy products, vegetable, fruit, grain and tuber food, and fat.

P = 0.697). Supplementary Figure 1, http://links.lww.com/CM9/C55 displays the ORs of the BMI categories associated with chronic diarrhea across the age, smoking, and alcohol consumption subgroups.

As shown in Figure 2, we employed restricted cubic splines to flexibly model and visualize the relationship between BMI and chronic diarrhea. In the total population (P <0.001 for linear, P = 0.017 for nonlinear) and among males (P <0.001 for linear, P = 0.026 for nonlinear), there were simultaneous linear and nonlinear associations between BMI and the risk of chronic diarrhea. However, this association was not statistically significant in females (P = 0.166 for linear, P = 0.223 for nonlinear). As BMI increased, the risk of chronic diarrhea showed an initial upward trend, followed by a plateau. In the different sex subgroups, a generally positive association was observed between BMI and the risk of chronic diarrhea at lower BMI ranges. However, the relationship

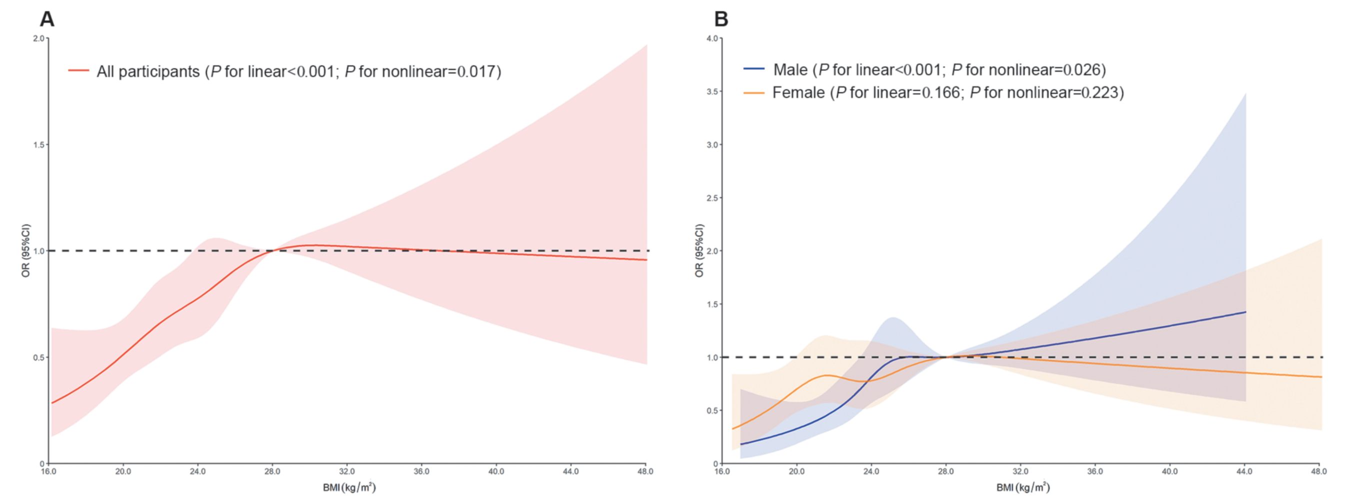

Figure 2: Restricted cubic splines of the relationship between BMI and chronic diarrhea. (A) All participants; (B) stratified by sex. Models are adjusted for age, sex, residence, ethnicity, marital status, type of work, residence, education level, annual household income, smoking status, alcohol drinking status, weekly exercise times, depressive status, and daily consumption of animal meat, egg, fish and shrimp, beans and soy products, milk and dairy products, vegetable, fruit, grain and tuber food, and fat. The BMI of 28 kg/m^2 was set as the reference point (OR = 1). The number of nodes in the spline function is k = 5. BMI: Body mass index; CI: Confidence interval; OR: Odds ratios.

at higher BMI ranges remained unclear [Figure 2B]. In particular, a clear positive linear association between BMI and chronic diarrhea was evident below 28 kg/m^2 [Supplementary Figure 2, http://links.lww.com/CM9/C55; *P* for linear values in the total men and women groups were <0.001, 0.002, and 0.044, respectively].

Discussion

This study presents initial findings on the prevalence of chronic diarrhea among residents of Chinese communities while offering substantiated evidence regarding the significant association between obesity and chronic diarrhea. The standardized prevalence of chronic diarrhea among urban and rural residents in Beijing was 12.88%. We discovered an association between higher BMI and chronic diarrhea, with this association more pronounced in males. Therefore, this study provides preliminary evidence regarding the epidemiological status of obesity and chronic diarrhea and their association. The research data effectively represented the community-level situation in the Beijing urban areas and served as a reference for the nationwide prevalence of chronic diarrhea.

A meta-analysis revealed that the prevalence of chronic diarrhea in obese adults was 23.79% (95% CI: 16.29%–31.29%).[28] However, a considerable degree of heterogeneity was observed in different studies. The largest study to date is from National Health and Nutrition Examination Survey,[16] which reported a weighted prevalence of chronic diarrhea of 6.6% in the population, with higher rates in females than those of males (7.8% *vs*. 5.4%). Among individuals with obesity, the prevalence of chronic diarrhea was 9.7%. However, chronic diarrhea was defined as BSFS types 6 and 7 in this population.[14,29] In contrast, according to the Chinese guidelines for diagnosing and treating chronic diarrhea, this study included BSFS type 5 within the scope of chronic diarrhea. The highest reported prevalence comes from a study based on an Australian community population, where the prevalence of chronic diarrhea in the population with obesity was 38.95%.[19] This study used a relatively broad definition of diarrhea, and the subgroup with obesity included only 172 participants. Another community-based study on a 26-year birth cohort reported a prevalence of 27.52%.[18] A study in Saudi Arabia included 737 individuals with a BMI between 30.0 kg/m^2 and 34.9 kg/m^2 and reported a prevalence of chronic diarrhea of 21.44%.[11] The complex interplay between genetic backgrounds and environmental factors in different populations may partially explain these discrepancies. However, further evidence is needed to confirm this hypothesis. Our study represents the first investigation that focuses on an East Asian population and is one of the few studies specifically targeting patients with chronic diarrhea sampled from the general community.

It has been previously shown that chronic diarrhea is associated with obesity[14–19] and that the risk of diarrhea increases with the severity of obesity.[14,18,19] However, based on previous knowledge of obesity-related health effects, most obesity management strategies have historically been recommended and implemented by nutritionists, endocrinologists, or cardiologists, with little involvement from gastroenterologists.[6] For chronic diarrhea without organic lesions accompanied by obesity, isolated treatment of diarrheal symptoms often does not work well. The latest view is that the coexistence of obesity and diarrhea may be regarded as a syndrome, and the exploration of its unique pathogenic mechanisms may lead to the discovery of effective treatments.[5] However, substantial clinical and experimental evidence is required to support this hypothesis.

In addition, we observed that the association between obesity and chronic diarrhea in different sex subgroups within the Chinese population is not entirely consistent. The occurrence rate of obesity was significantly higher in females than in males (18.93% *vs*. 13.97%, *P* <0.001), consistent with previous reports.[16,30] Anbardan *et al*[31] analyzed sex differences in IBS and found that males had higher bowel frequency and greater stool looseness as compared with females. However, in the BCGHS population, there was no difference in the prevalence of chronic diarrhea between females and males. Furthermore, hormonal differences, particularly the influence of estrogen in females, play an essential role in fat distribution and metabolism.[16,30] Hormones may partially explain the differences in the risk of chronic diarrhea through their effects on gastric motility, visceral sensitivity, and gut microbiota.[16,30] Males tend to accumulate visceral fat around the abdominal region, resulting in "apple-shaped obesity", while females tend to store fat in the subcutaneous areas around the hips and thighs, leading to "pear-shaped obesity".[16,30] Differences in fat distribution are associated with various health outcomes, particularly metabolic disturbances.[32] Therefore, further examining the association between fat distribution and chronic diarrhea may provide additional explanations for the observed sex differences. However, it should be noted that the statistical power of subgroup analysis may be limited by sample size, especially within the association range of BMI >28 kg/m^2, and further research is warranted in this regard.

Currently, the mechanisms by which obesity and diarrhea coexist are unclear and can be attributed to several factors. First, rapid gastric emptying and accelerated colonic transit have been reported in some individuals with obesity, which may be a potential cause of the BMI-related increase in bowel movement frequency.[33–35] Second, altered intestinal permeability is associated with altered metabolism in animal models of obesity.[36] Human studies have also found that intestinal permeability parameters in individuals with obesity positively correlate with anthropometric and metabolic variables. Third, the gut microbiome may have played an essential role in this association. Individuals with *Bacteroide*-dominant gut microbiota can extract nutrients from food more efficiently while reducing intestinal transit time.[37] Several studies have shown an increased *Firmicutes* to *Bacteroides* ratio in obesity.[38] In particular, metabolites of the gut microbiota short-chain fatty acids may play a key role in obesity and diarrhea.[39] However, further human studies are needed for verification. In addition, disturbances in bile acid metabolism,[40,41] and intestinal inflammation may also play a role in this association.[42]

This study has several limitations. First, its cross-sectional design constrained this study, precluding causal inferences from derivation. Longitudinal investigations focusing on the relationship between obesity and chronic diarrhea will shed further light on the predictive factors of chronic diarrhea and offer potential targets for future interventions. Second, the assessment of chronic diarrhea relied on BSFS rather than clinical diagnosis. Adopting the BSFS according to the Rome criteria for defining diarrhea and its recognition as an outcome measure for diarrhea predominant-irritable bowel syndrome (IBS-D) by the U.S. Food and Drug Administration lends credibility to its usage.[43] As a population-based study primarily aimed at reporting disease prevalence and generating hypotheses, the bowel health questionnaire provides a practical tool extensively employed and validated in analogous research endeavors.[14,16,44] However, despite a random sampling design, there might have been some sampling bias due to the methodological constraints of community-based epidemiological surveys. For instance, the probability of interviewing retired individuals in a community was higher than interviewing younger individuals. However, to mitigate the impact of unrepresentativeness, we reweighted the sample in the prevalence calculation, using the standard population of Beijing as a reference.

In conclusion, we found that the prevalence of chronic diarrhea in a representative Chinese population of urban and rural residents was 12.88%. After adjusting other factors, a significant independent association was observed between higher BMI and chronic diarrhea, particularly in males. These findings offer novel perspectives for gastrointestinal health management. By addressing obesity as a potential risk factor, healthcare professionals can optimize patient care and enhance the quality of life of patients with chronic diarrhea. However, further large-scale prospective studies are necessary to validate our findings and provide additional insights into the causal inferences and underlying mechanisms of this association.

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Conflicts of interest

None.

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